



ENGINEER  
NEXT

NIDays

The logo features the words "ENGINEER" and "NEXT" in a bold, white, sans-serif font, stacked vertically. A yellow graphic element, resembling a stylized 'X' or a folded ribbon, is positioned between the two words. To the left of this text, the word "NIDays" is written in a smaller, white, sans-serif font, enclosed within a white rectangular border. The entire logo is set against a blue background with diagonal stripes in various shades of blue, orange, and green.





# Bonnes pratiques d'architecture de systèmes de test automatique

## Smarter Test for Advanced Aerospace and Defense Electronics



# Best Practices Depend on Your Perspective



Latest Consumer Device



B-52 Stratofortress

# Challenges of ATS Development and Proliferation

## Development

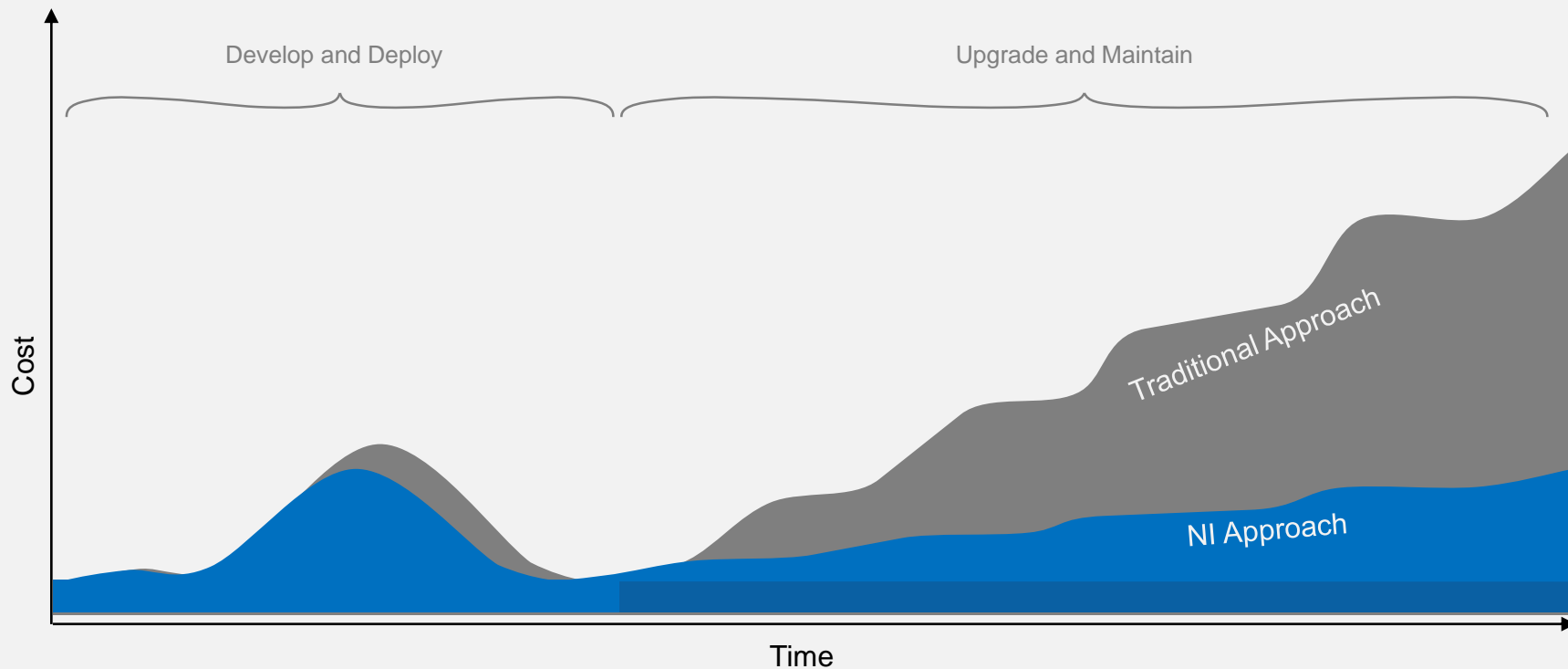
- Fixed schedule and budget
- Future technology insertion
- Common versus custom

## Maintenance

- Long product life cycle
- Obsolete equipment
- Instrument failure
- Costly TPS changes
- Total cost of ownership



# Total Cost of Owning an Automated Test System







AEROSPACE  
AND DEFENSE

**HARRIS**

## Harris Reduces Cost of Test While Increasing Test Throughput 400 Percent With NI

74% Decrease in Cost of Test

83% Reduction in Floor Space



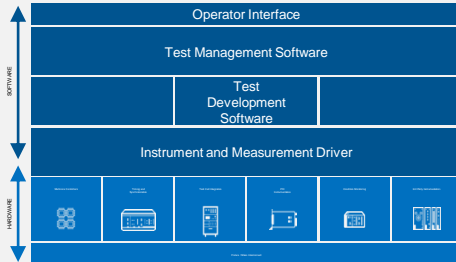


AEROSPACE  
AND DEFENSE

**HARRIS**<sup>®</sup>

“The NI platform gave us the ability to significantly scale our production test throughput by 400 percent with an ROI of 185 percent while carefully maintaining the quality and performance standards that our military radios are known for.”

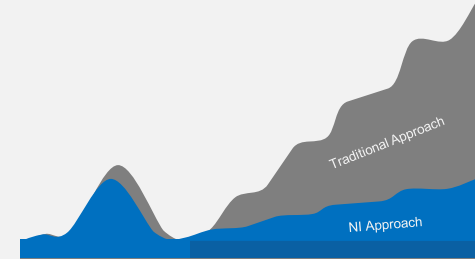
# 3 Best Practices for Architecting an ATE System



Develop a Scalable and Reusable Software Architecture



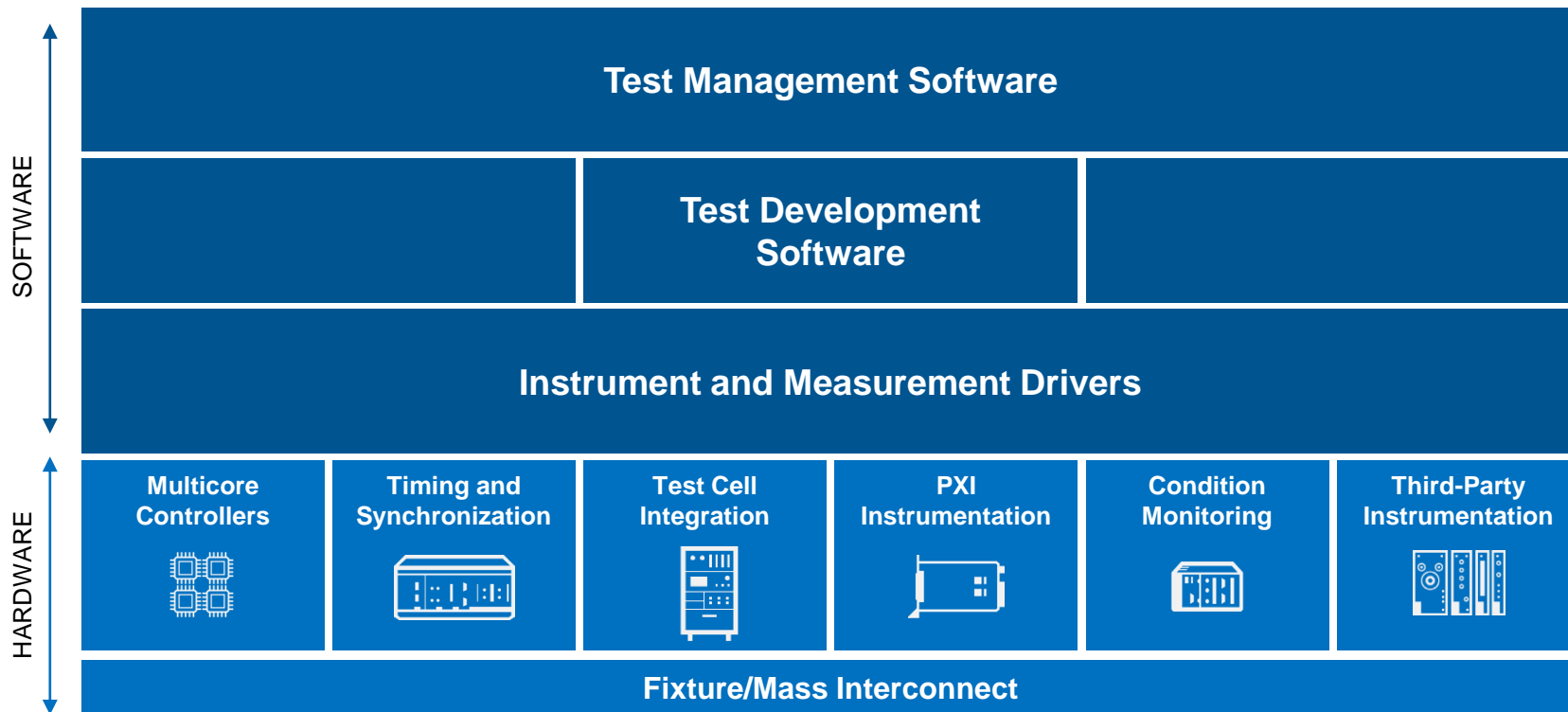
Standardize on the Latest Off-the-Shelf Hardware



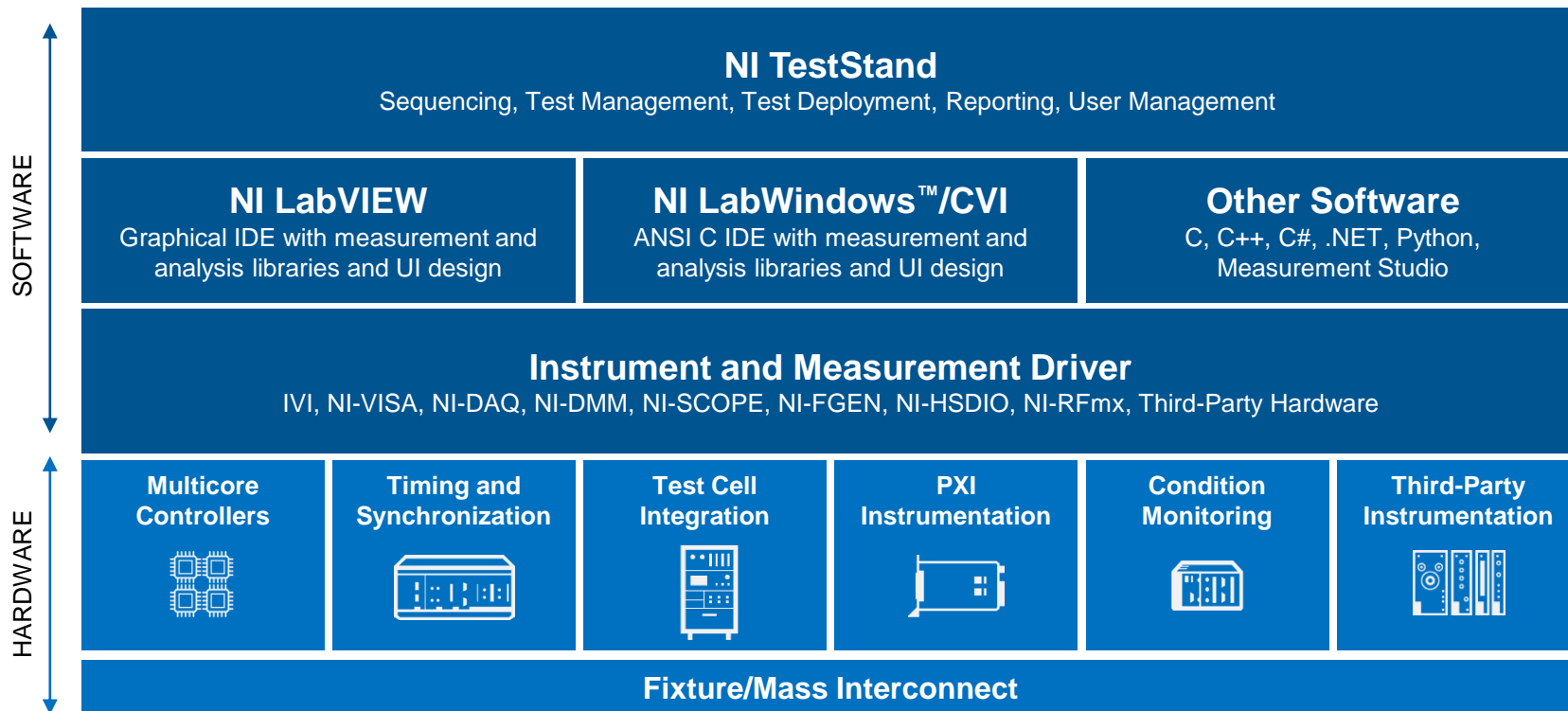
Plan for Obsolescence

# Develop a Scalable and Reusable Software Architecture

# Architecture of an Automated Test System



# Architecture of an Automated Test System



# Separating Software Responsibilities

## COMMON

### Test Management Software

- Limit checking
- Integration of system-level requirements
- Results processing
- Shared measurements
- Operator interface
- User management
- Test flow control

## UNIQUE

### Test Development Software

- Instrument control
- Stimulus
- Analysis code
- DUT control
- DSP
- Tracking of individual test requirements

# TestStand

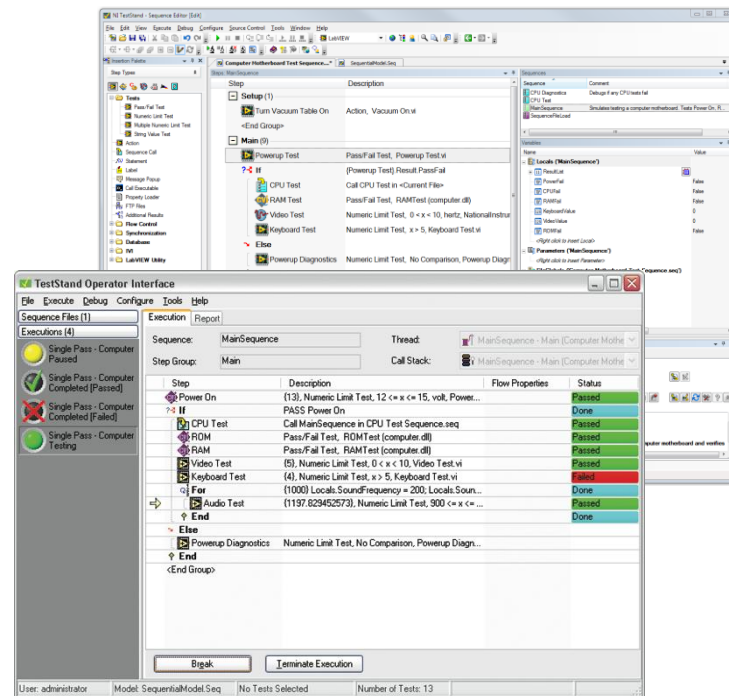
## Industry-Standard Test Management Software

- Author, execute, and debug test sequences
- Leverage test code developed in **any language**
- Test many devices in parallel
- Generate reports
- Integrate with databases
- Extend the software to meet custom requirements
- Develop professional operator interfaces

6,000+  
COMPANIES  
WORLDWIDE

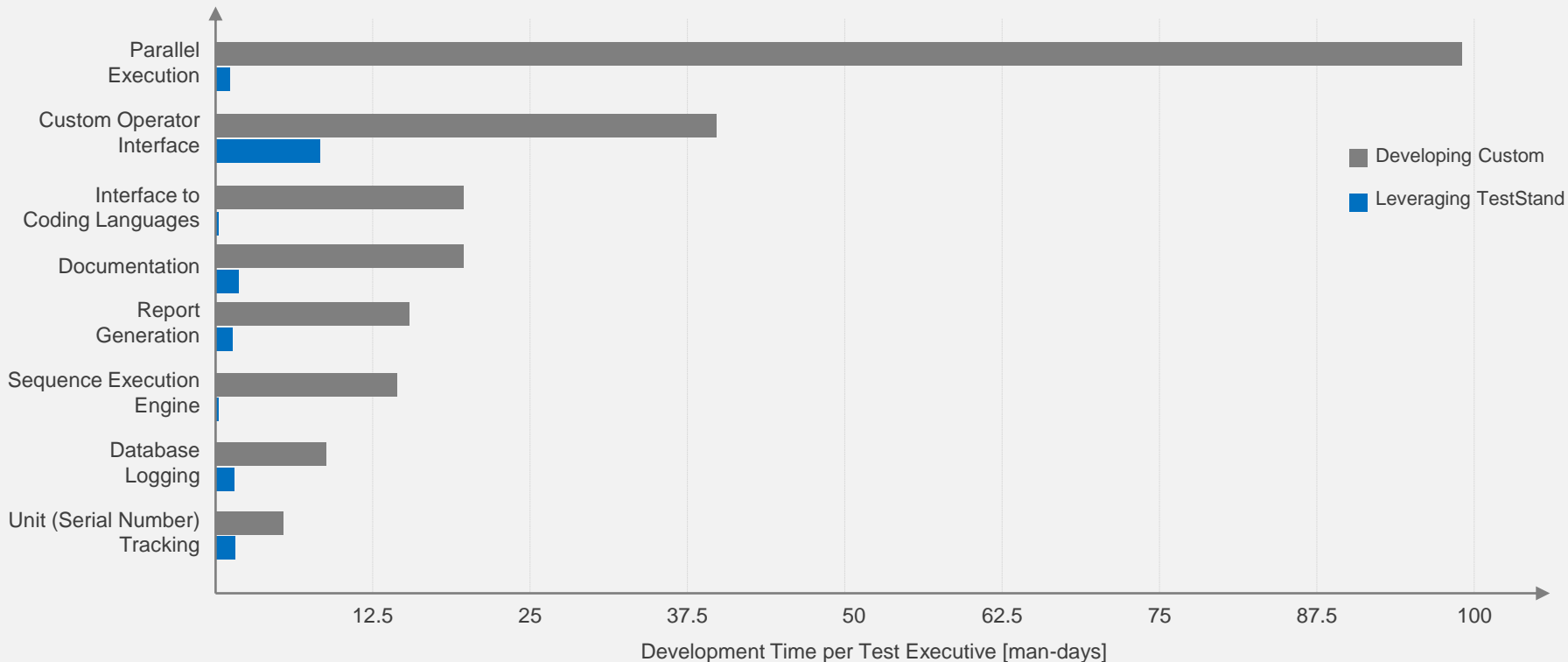
10,000+  
EXISTING  
DEVELOPERS

1,500+  
NEW DEVELOPERS  
TRAINED ANNUALLY



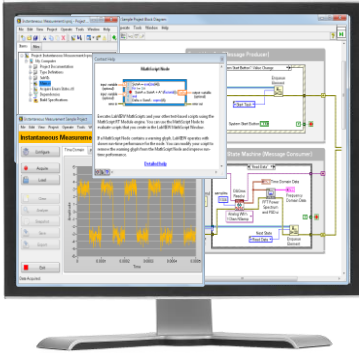


# Increase Productivity With COTS Test Management Software



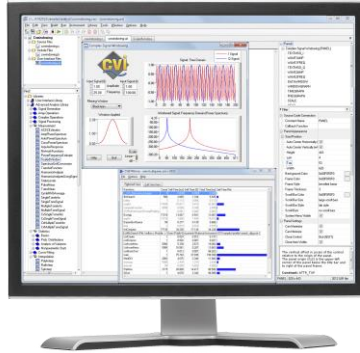
# TPS Application Development Environments (ADEs)

LabVIEW



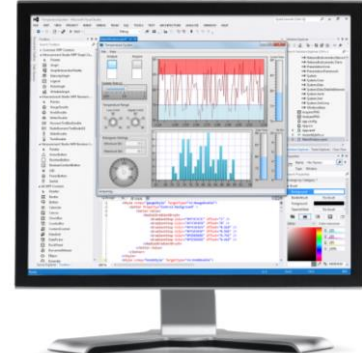
System Design  
Software

LabWindows™/CVI



Proven ANSI C IDE and  
Engineering Toolbox

Measurement Studio

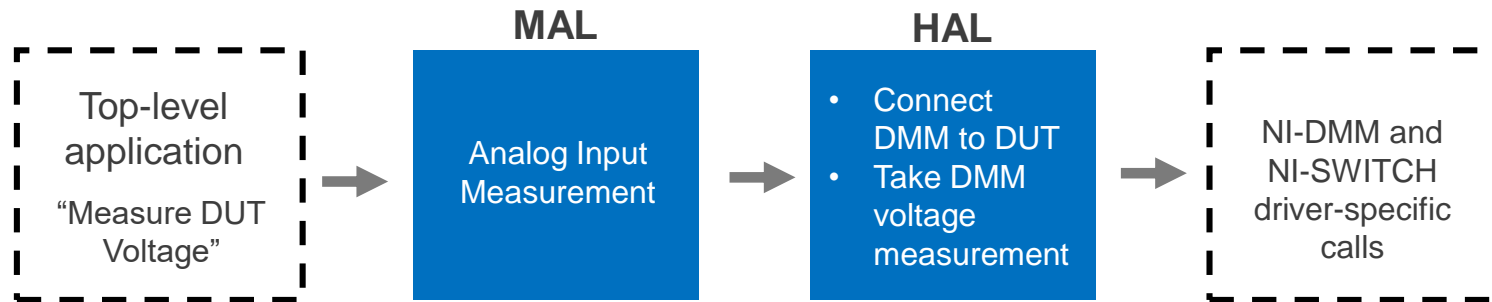


.NET Tools Designed  
for Engineering

# Architecting for Scalability and Reusability

**Hardware Abstraction Layer (HAL):** layer of programming that allows an automated test system to interact with a hardware device at a general level or an abstract level rather than at a detailed hardware level

**Measurement Abstraction Layer (MAL):** layer of programming that allows an automated test system to interact with a DUT through high-level actions rather than at a detailed hardware level



# Implementing an Abstracted Architecture

Abstraction is a spectrum.

Start by taking advantage of out-of-the box abstraction layers.

## Hardware Abstraction

- NI family drivers
  - NI DMM support for all NI 40xx instruments
- IVI-compliant drivers



- Custom HAL

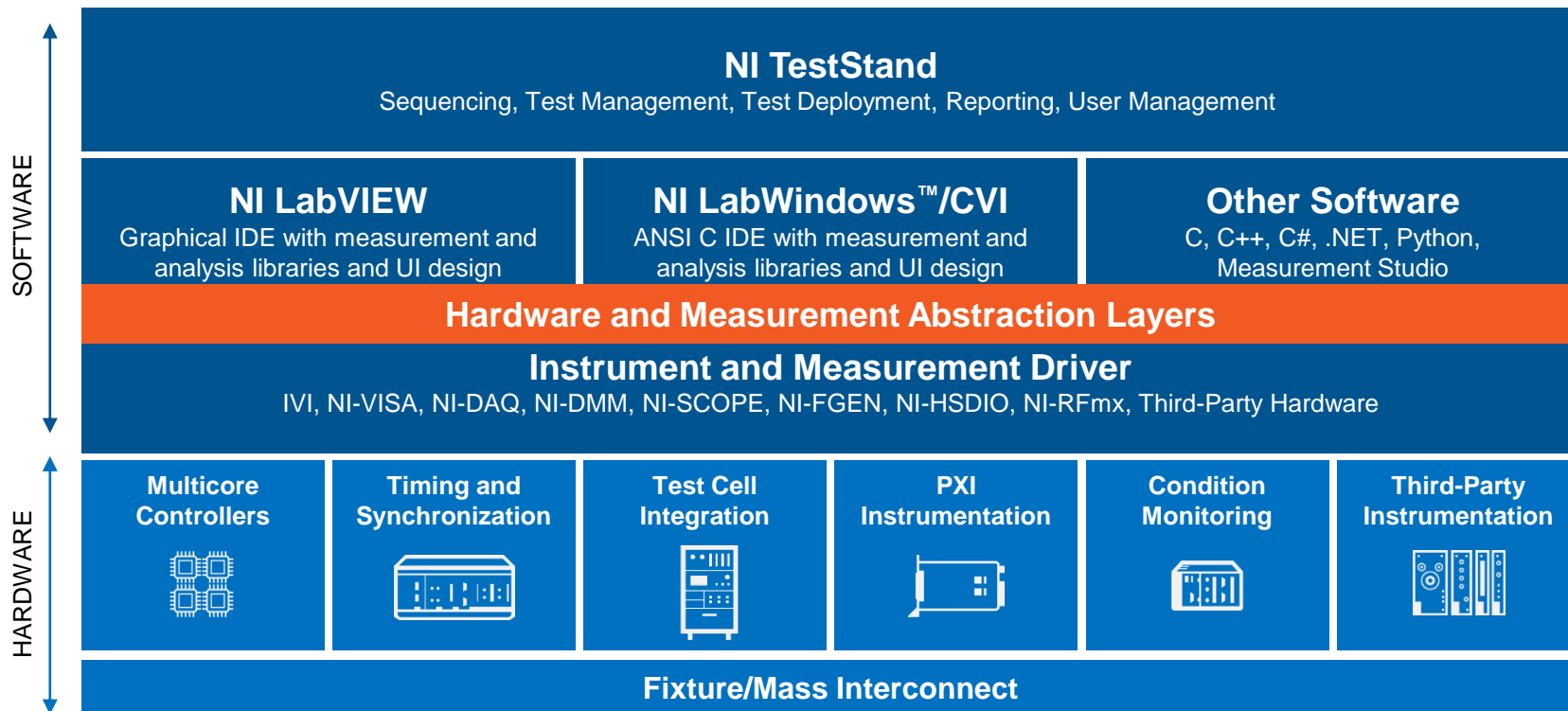
## Measurement Abstraction

- TestStand custom step types
- LabVIEW subVIs
- NI Switch Executive

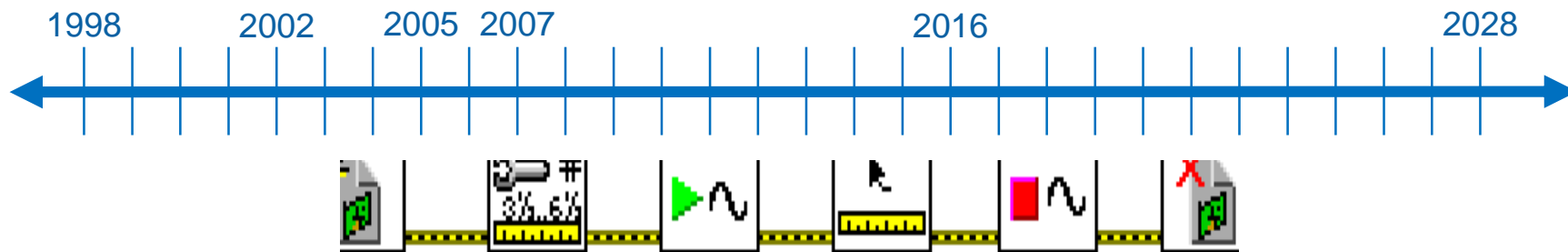
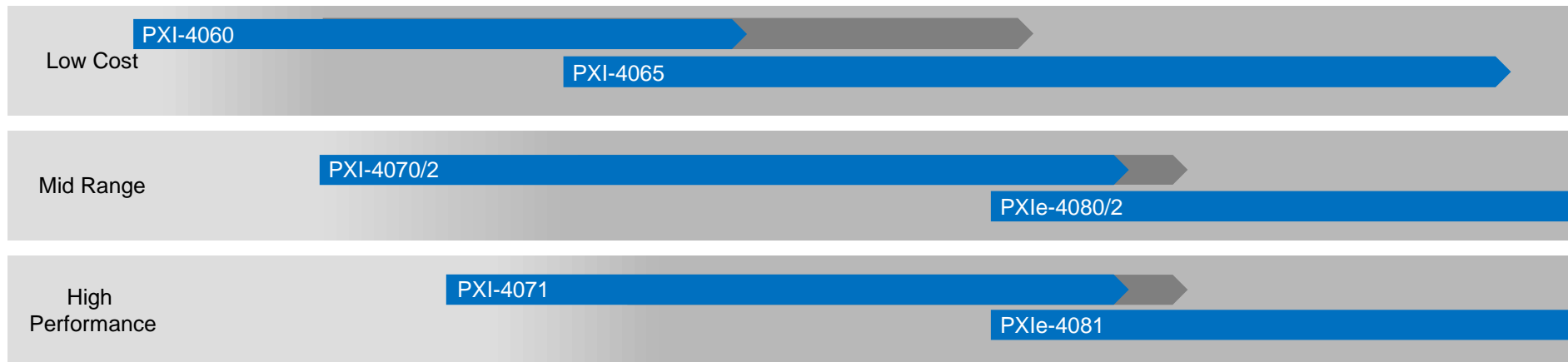


- Custom MAL

# Hardware and Measurement Abstraction Layers



# NI-DMM Hardware Abstraction





9X Reduction in Test Development Time

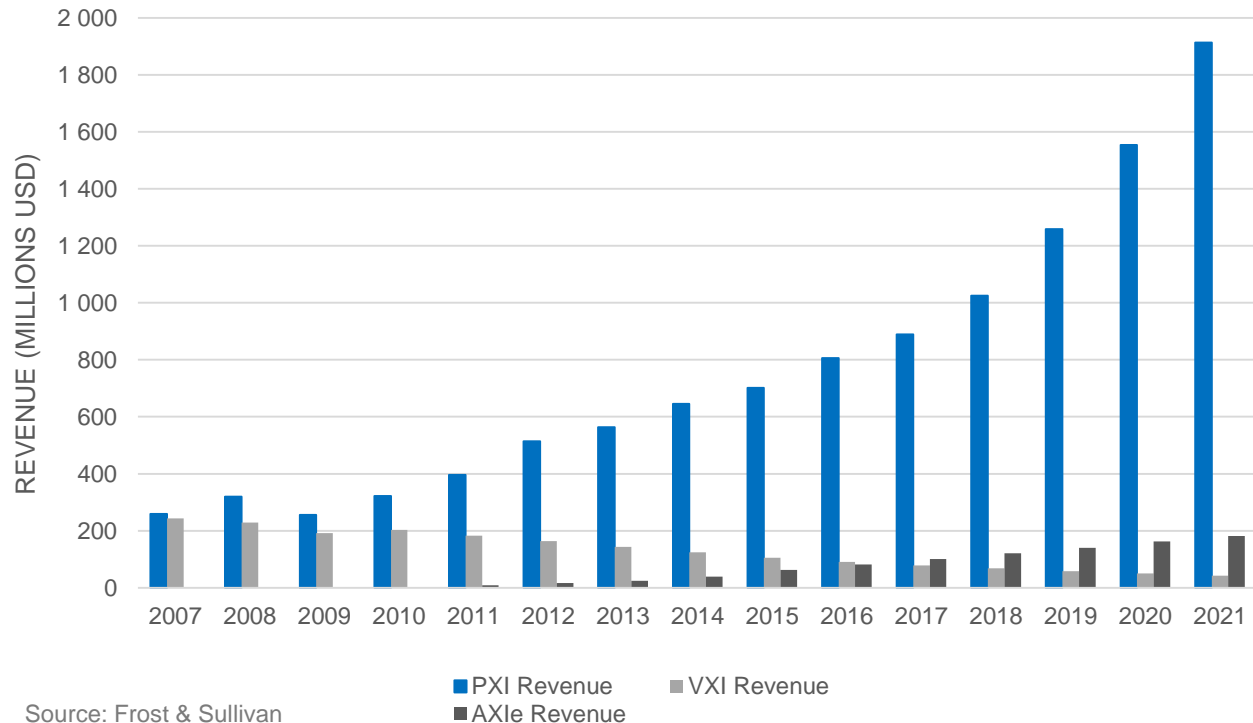
60% Code Reuse

“By leveraging commercial off-the-shelf software technologies such as TestStand and LabVIEW, our Automated Test Engineering team was able to achieve up to 60 percent code reuse for each automated test and reduce overall test development time by up to 9X. Using the NI certification program, coupled with in-house training, we were able to develop the skills necessary to produce robust, flexible code and maintain it across over 200 test benches.”



# Standardize on the Latest Off-the-Shelf Hardware

# Modular Instrumentation (PXI) Drives ATE



Source: Frost & Sullivan

- Founded in 1997
- 60+ Vendors
- 2000+ Modules
- Latest Technology
- Growing Market Share

# NI's Industry-Leading Test and Measurement Solution



PXIe-5162  
4 ch, 1.5 GHz,  
10-Bit Digitizer



PXI-4081  
7½-Digit, 1 kV Precision  
DMM



PXIe-5668R  
26.5 GHz VSA With  
765 MHz Bandwidth



PXIe-4135  
Precision System SMU  
10 fA Sensitivity



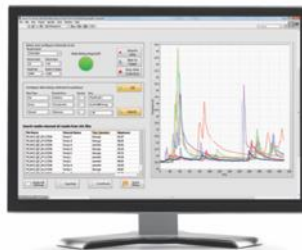
PXIe-5646R  
6 GHz Vector Signal  
Transceiver



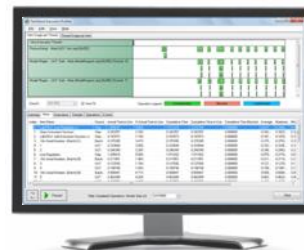
PXIe-1085  
PXI Chassis  
24 GB/s Throughput



PXIe-8880  
PXIe Controller  
8-Core Intel Xeon



LabVIEW  
System Design  
Software



TestStand  
Test Management  
Software



PXIe-2543  
6 GHz, 8 ch, Solid-State Mux

# Second-Generation Vector Signal Transceiver

## Features at a Glance

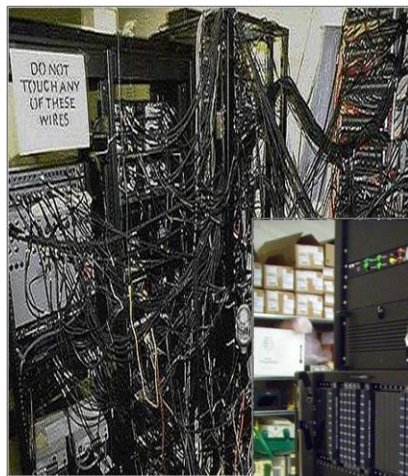
- User-programmable FPGA with LabVIEW
- 1 GHz of instantaneous bandwidth for advanced digital predistortion test and wideband signals
- Excellent accuracy enables measurement of 802.11ax error vector magnitude performance of -50 dB
- FPGA enables measurement speeds up to 10X faster than traditional instrumentation
- Small size and tight synchronization allow for up to 8x8 MIMO configuration in a single 18-slot chassis

## Application Areas

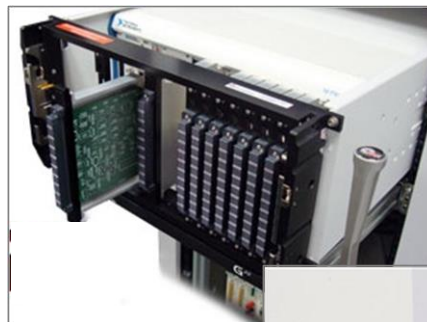
- Wireless test
- Semiconductor test
- Automotive radar



# Mass Interconnect and ITAs



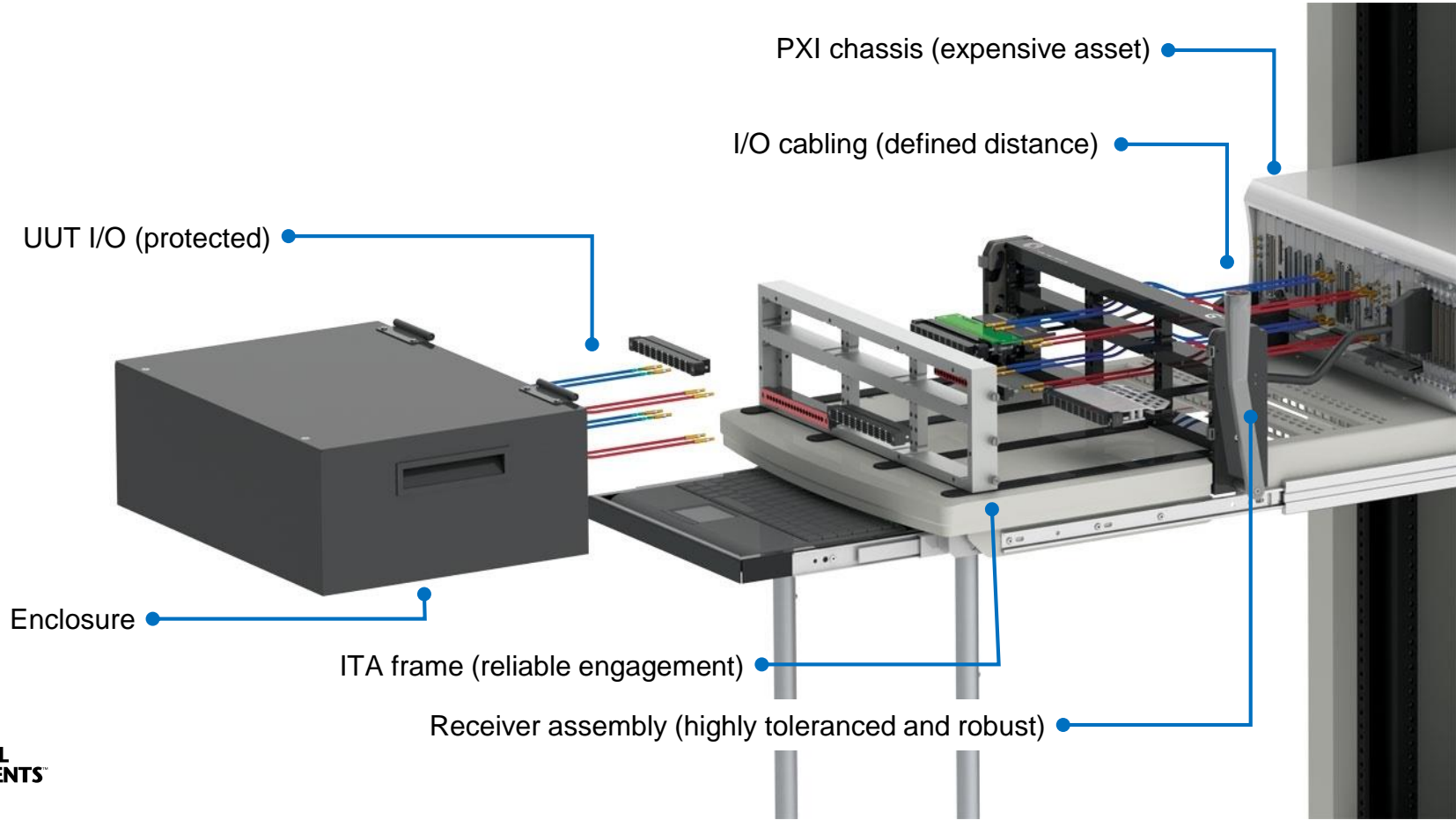
VS.



PCB-Based  
or  
Cabled Connection



# Elements of a Typical Mass Interconnect



# Standardize, Standardize, Standardize

How many DC-programmable power supplies are in your library?

How about 6½-digit DMMs?

## General Rule

Standardize what you can, as fast as you can,  
if the differences aren't adding value.



# NI ATE Core Configurations Make Standardization Easier

Standardized starting point for in-house ATE development



40U Configuration

24U Configuration



Category	Details
<b>Mechanical</b>	40U and 24U Rack Height With Industrial-Grade Casters and Mounting Rails
<b>Power</b>	Power Distribution Unit, Power Entry Panel, and Optional Uninterruptible Power Supply
<b>Safety</b>	Emergency Power Off, Thermal Shutdown, Multilevel Circuit Protection
<b>Instrumentation</b>	PXI, CompactDAQ, CompactRIO, SLSC, Third-Party
<b>Cooling</b>	24 VDC Fan Kit, Air Filtration
<b>Cabling</b>	Integrated Cable Management and 10/100 ENET Switch

# Plan for Obsolescence

# Life-Cycle Management Practices



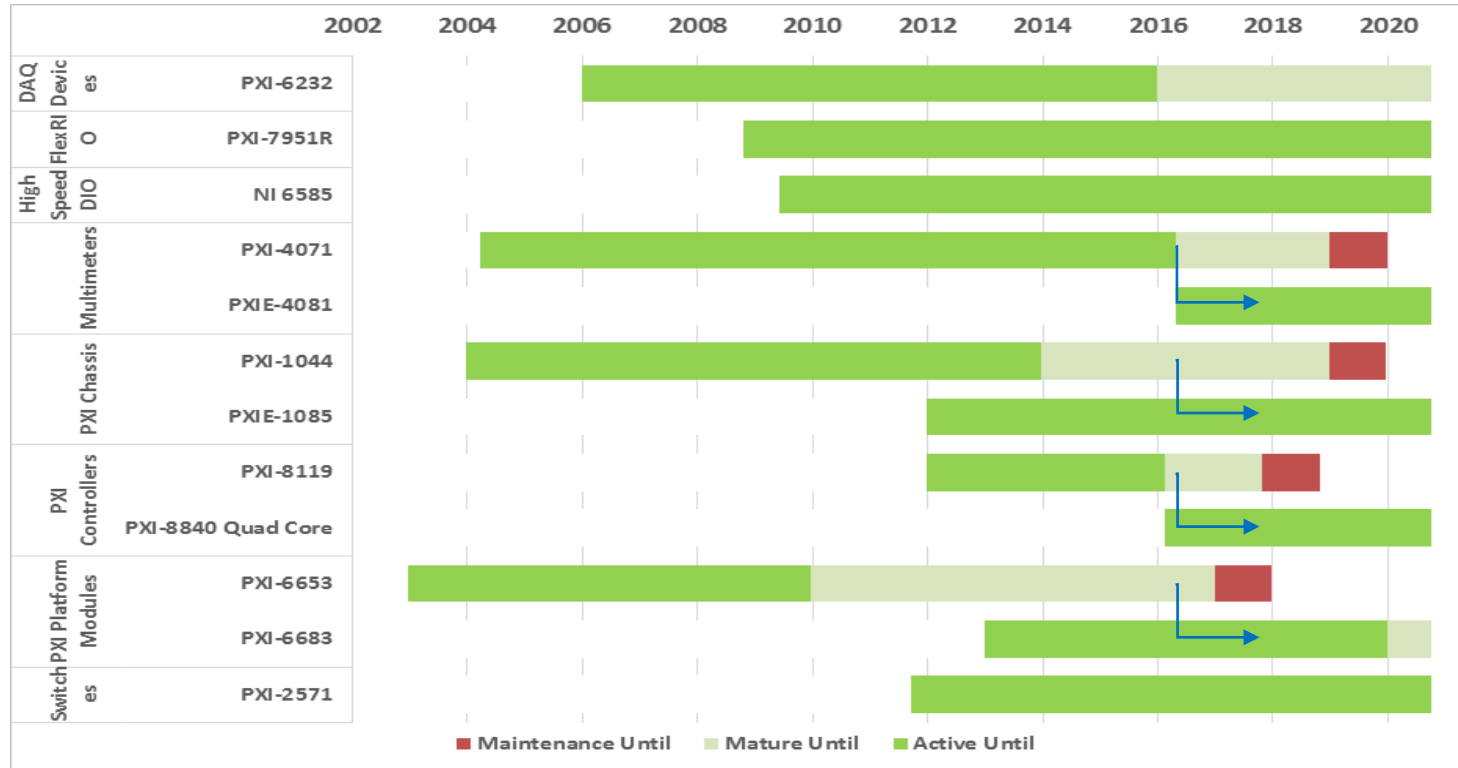
## Proactive/Strategic

- Modular open architectures
- Technology roadmapping
- Planned system upgrades
- Technology insertion planning
- Life-cycle analysis and monitoring
- Formal life-cycle strategy

## Reactive/Tactical

- Alternate source
- Substitution
- Redefine requirement
- Emulation
- Lifetime buy
- Redesign
- Reverse engineer
- Reclamation

# Example Life-Cycle Analysis





23% Decrease in LRU Repair Time

80% Reduction in Quality Deficiency Reports

18 Obsolete Test Sets Replaced

“CACI selected many NI instruments for the core of the CBATS test system based on the relationship with the company and the quality of its products. CACI’s relationship with NI has grown to a level of mutual trust as we work together to deliver high-quality, sustainable test solutions at affordable prices.”

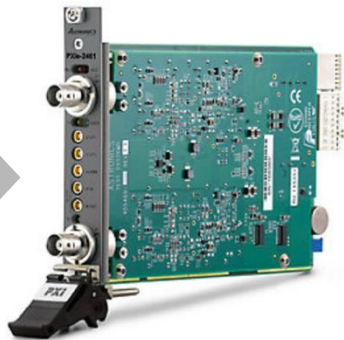
CACI

# NI and Astronics Collaborate on VXI to PXI Transition



**Astronics VXIbus 2461C**

2-Channel, 200 MHz Frequency Time Interval Counter



**Astronics PXIe-2461 for PXI Express**

2-Channel, 200 MHz Frequency Time Interval Counter



**Astronics PXIe-2461**

2-Channel, 200 MHz Frequency Time Interval Counter

**Astronics PXIe-6943**

32-Channel, 200 MB/s Digital I/O Module

**Astronics PXIe-3352**

Rubidium Clock Source Module

**Astronics PXIe-1209**

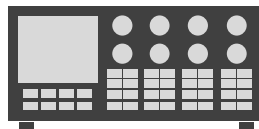
100 MHz Pulse Pattern Generator Module

“Full TPS and Driver Compatibility”

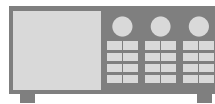
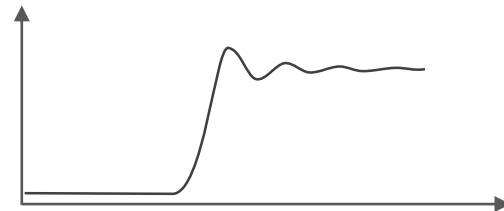
# Emulating Legacy Instrumentation

## Challenge

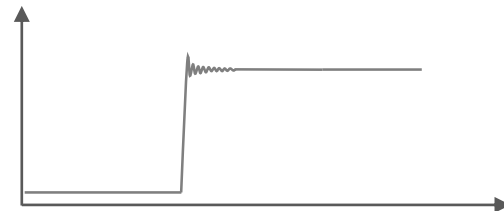
- Previous instrument is end of life
- New instrument behavior
- Test system depends on old behavior
  - Trigger types
  - Analog bandwidth
  - Sample rate
  - Dynamic range



Legacy Instrument

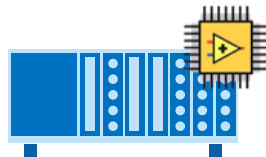


New Box Instrument

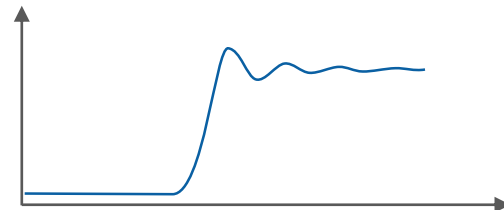


## Solution

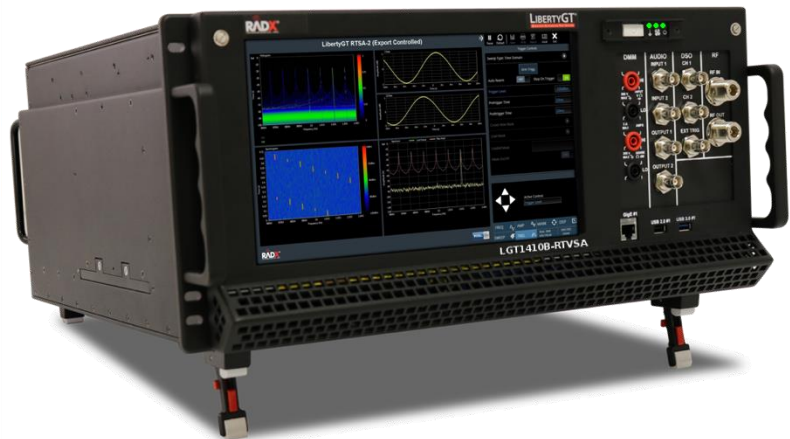
- Software-defined instrumentation
- Digital signal processing
- FPGA technology



Software-Defined Instrument







# Real-Time Spectrum Analysis

100% POI with full accuracy on 320 ns minimum duration signals from 20 Hz to 26.5 GHz

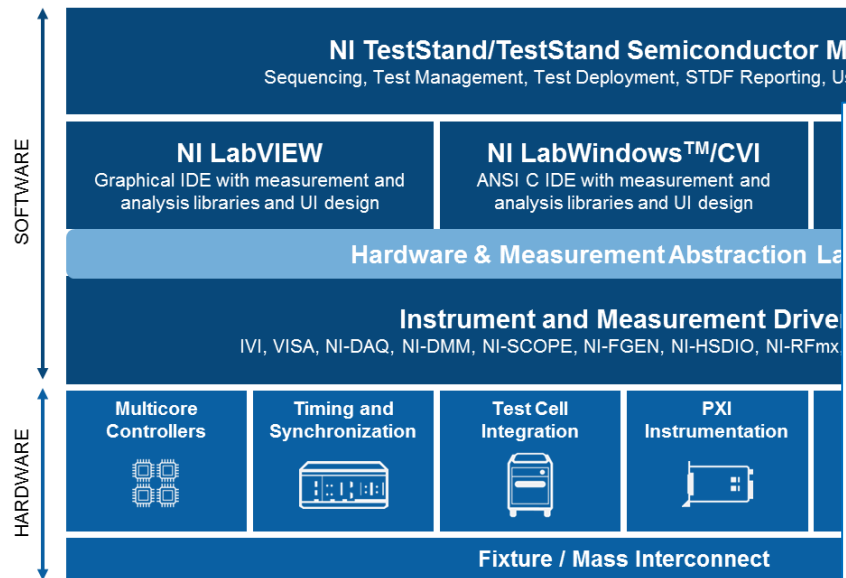
765 MHz analysis bandwidth and real-time DSP throughput of up to 62 million FFTs

“NI’s PXIe technology provides unparalleled scalability, upgradeability, and technology insertion capability that minimizes obsolescence, repair, and test program portability issues that plague box instruments.”



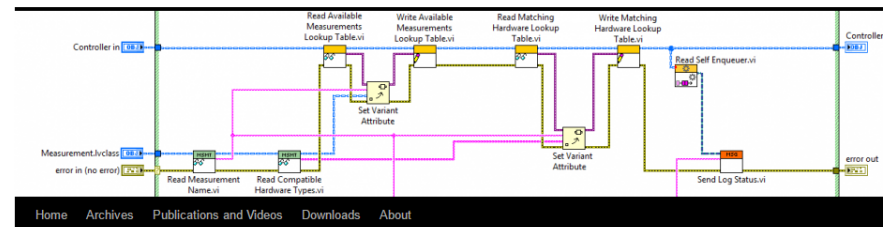
# Summary

# Architecture of an Automated Test System With Abstraction



## Software Engineering for LabVIEW

A Guide to Graphical System Design



← 2013 CLA Summit Kick-Off

Getting Started with LabVIEW in Under 10 Minutes →

Advertisements

## Designing and Deploying a Plug-in LabVIEW Measurement System with Multiple Abstraction Layers Using the Actor Framework

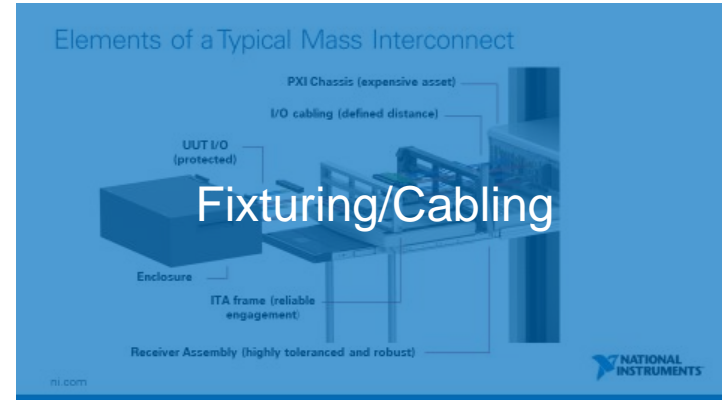
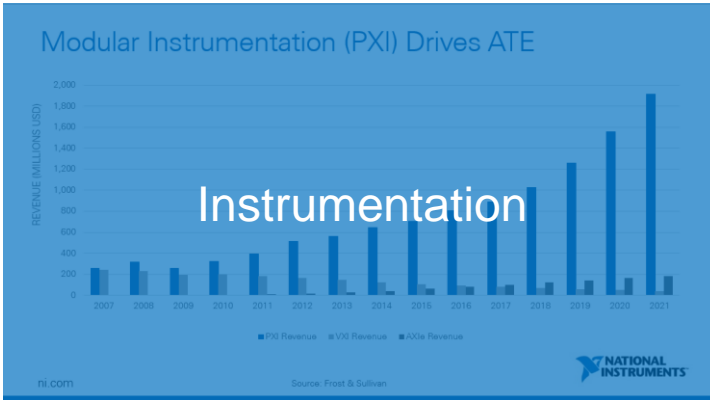
Posted on [March 28, 2013](#)

★★★★★ 9 Votes

I developed the [Measurement Framework](#) over the last year in order to experiment with and explore some of the latest architectures, technologies and design approaches that are becoming increasingly important for large LabVIEW systems. I've used sections of this application to illustrate technical topics in previous posts, but I wanted to use today's entry to explore the overall design of this system and several of lessons I learned. My hope is to provide insights for any of you that are attempting to address similar requirements. I also hope to lay the groundwork to some deeper-dives into some of these topics in future entries.

## Fundamentals of Building a Test System

# ATE Hardware Architecture Considerations



## NI ATE Core Configurations Make Standardization Easier

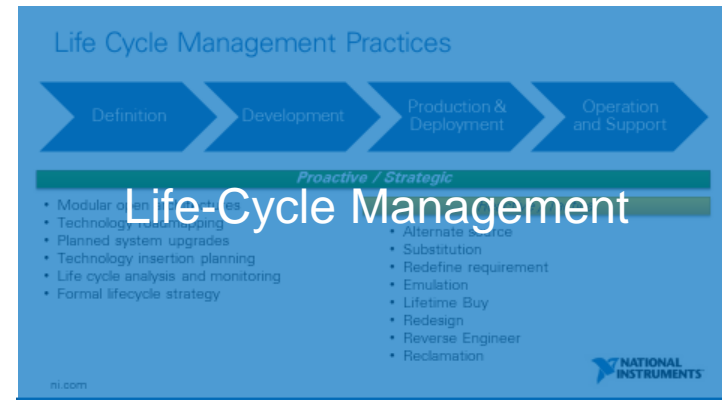
Standardized starting point for in-house ATE development

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<b>Safety</b>	Emergency Power Off, Thermal Shutdown, Multi-Level Circuit Protection
<b>Instrumentation</b>	PXI, cDAQ, cRIO, SLSC, 3 <sup>rd</sup> Party
<b>Cooling</b>	24 VDC Fan Kit, Air Filtration
<b>Cabling</b>	Integrated Cable Management and 10/100 ENET Switch

ni.com



# Global Service and Support, Locally Delivered



\*Provides NI Repair, Calibration, and Inventory Services



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